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Vulnerable territories and the right to water in the Piracicaba, Capivari, and Jundiaí river basins

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Abstract

Objective: The objective of this work is to evaluate whether, in the Piracicaba, Capivari, and Jundiaí (PCJ) River Basins, their managers can dimension, integrate, or foresee the right to water and sanitation for populations, which, due to their condition of social, economic, or geographic distribution are in a situation of territorial vulnerability.

Methodology: The methodological path adopted consisted of a bibliographical literature review and a punctual analysis of the Situation Report of Water Resources in the PCJ Basins 2021, base year 2020.

Originality/Relevance: The most significant academic contribution is the proposition of theoretical mechanisms that support the scope of the universality of supply services and the difficulties faced in the territory for access to this common and finite good, water. The relevance and originality of the study consist in showing, in its methodology and results, how territorial vulnerability is among the main strategic challenges of the sustainable management of water resources.

Results: The main result achieved in the study indicates that in most of the urban regions of the municipalities analyzed, public service for water supply is widespread. However, access is not of good quality and universal.

Social/management contributions: The authors' main expectation is to be able to contribute to the advancement of discussions on the issue of universal access to water and sanitation and to provide, within the scope of public policies, analytical paths for the sustainable management of water resources.

Keywords: sustainability, territory, vulnerability, urbanization, water resources.

TERRITÓRIOS VULNERÁVEIS E O DIREITO À ÁGUA NAS BACIAS HIDROGRÁFICAS DOS RIOS PIRACICABA, CAPIVARI E JUNDIAÍ

Objetivo: o trabalho tem como objetivo avaliar se nas Bacias Hidrográficas dos Rios Piracicaba, Capivari e Jundiaí – Bacias PCJ –, os gestores dimensionam, integram ou preveem o direito à água e ao saneamento para populações que, por sua condição social, econômica ou de distribuição geográfica, encontram-se em situação de vulnerabilidade territorial.

Metodologia: o caminho metodológico adotado consistiu na revisão bibliográfica de literatura e da análise pontual do Relatório de Situação dos Recursos Hídricos nas Bacias PCJ 2021 – Ano Base 2020.

Originalidade/Relevância: a relevância e originalidade do estudo consiste em mostrar, em sua metodologia e resultados, como a vulnerabilidade territorial está entre os principais desafios estratégicos da gestão sustentável dos recursos hídricos. A contribuição acadêmica mais significativa é a proposição de mecanismos teóricos que sustentam o alcance da universalidade do atendimento dos serviços de abastecimento e, também, as dificuldades enfrentadas no território para o acesso a esse bem comum e finito que é a água.

Resultados: o principal resultado alcançado no estudo indica que na maioria das regiões urbanas dos municípios analisados o serviço de atendimento público para o fornecimento de água ocorre de maneira ampla. Todavia, o acesso não é de qualidade e universal.

Contribuições sociais/para a gestão: a principal expectativa dos autores é a de poder contribuir para o encaminhamento das discussões a respeito da temática do acesso universal à água e saneamento, e fornecer, no âmbito das políticas públicas, caminhos teóricos e metodológicos para a gestão sustentável dos recursos hídricos.

Palavras-chaves: sustentabilidade, território, vulnerabilidade, urbanização, recursos hídricos.

TERRITORIOS VULNERABLES Y DERECHO AL AGUA EN LAS CUENCA DE LOS RÍOS PIRACICABA, CAPIVARI Y JUNDIAÍ

Objetivo: el objetivo de este trabajo es evaluar si en las Cuencas de los Ríos Piracicaba, Capivari y Jundiaí - Cuencas PCJ, sus gestores pueden dimensionar, integrar o prever el derecho al agua y al saneamiento para las poblaciones que por su condición social, económica o geográfica distribución se encuentran en situación de vulnerabilidad territorial.

Metodología: el camino metodológico adoptado consistió en una revisión bibliográfica de la literatura y un análisis puntual del Informe de Situación de los Recursos Hídricos en las Cuencas PCJ 2021 - Año Base 2020.

Originalidad/Relevancia: el aporte académico más significativo es la proposición de mecanismos teóricos que sustentan el alcance de la universalidad de los servicios de abastecimiento y las dificultades que enfrenta el territorio para el acceso a este bien común y finito que es el agua. La relevancia y originalidad del estudio consiste en mostrar, en su metodología y resultados, cómo la vulnerabilidad territorial se encuentra entre los principales desafíos estratégicos de la gestión sostenible de los recursos hídricos.

Resultados: el principal resultado alcanzado en el estudio indica que, en la mayoría de las regiones urbanas de los municipios analizados, el servicio público de abastecimiento de agua está generalizado. Sin embargo, el acceso no es de buena calidad y universal, ya que está ausente en áreas rurales o con baja densidad de población.

Contribuciones sociales/de gestión: la principal expectativa de los autores es poder contribuir al avance de las discusiones sobre el tema del acceso universal al agua y al saneamiento y brindar, en el ámbito de las políticas públicas, vías de análisis para la gestión sostenible de los recursos hídricos.

Palabras clave: sostenibilidad, territorio, vulnerabilidad, urbanización, recursos hídricos.

Introduction

Faced with the challenges posed by the intermittent, seasonal, and inconsistent water volumes that water resource managers must deal with daily, the main concern seems to be how to guarantee universal access to water in a quality and quantity suitable for human life. This task is complex, with many aspects to consider.

Therefore, the central theme of this text involves dealing with the water issue from a procedural and systemic perspective. Certainly, human activity, more than immediate results, leads to consequences that, in general, become irreversible and often compromise the flow of resources and the sustainability of the conditions of use previously found (Mariosa et al., 2019). However, this does not occur in a uniform and homogeneous way. What allows us to evaluate and define the territory's vulnerability lies at the intersection of complementary and self-reinforcing factors (Kunzler, 2004; Mariosa et al., 2015; Maturana & Garcia, 1997). The relationship established between impacts, risks, and the consequent deterioration of the processes of appropriation and occupation of space with the socioeconomic conditions of populations tends to vary, as it depends on the system's response mechanisms to environmental changes (Oliveira Santos & Souza, 2014). For managers, analysts, and public policymakers, the first challenge is to understand the historicity of vulnerable spaces or territories; the second is to identify the conditions of their existence, aiming for adjustments and possible corrections.

As a result of increasingly intense processes, equally complex and sophisticated techniques in the daily use of fossil energy, and the unexpected effects of industrialization, the perception that we were heading towards an imminent situation of global environmental risk began to consolidate, especially in the countries of Western Europe, from the 1950s onwards. Irreversible actions, on the one hand, and finite resources, on the other, led researchers from several countries and the most diverse areas of study to finally understand that the economic, political, natural, and social components are all interconnected (A. O. K. Pereira et al., 2009). The concern "[...] with the continuity of economic and population growth, in which the scarcity of

natural resources and environmental degradation were highlighted as factors that limited, in absolute terms, this growth [...]" (Piga & Mansano, 2015, p.180) made the environmental issue a political one and was gradually incorporated into actions and strategies, firstly by the State and Agencies and Multilateral Organizations and, subsequently, involving private agents, opinion makers and society as a whole.

At the end of the United Nations Conference on the Environment, held in Stockholm, Sweden, in 1972, its members declared that protecting and improving the environment for current and future generations would be a non-negotiable goal for humanity. With this, protocols of intentions and recommendations were established to guide the formulation and implementation of public policies in each participating country, aiming to preserve natural resources and their sustainable use (Roma, 2019). What followed was that at each meeting or conference dealing with climate, the environment, or climate change and its effects on the global environment, new goals and objectives were being set, and significant portions of society were encouraged to comply.

The most recent document is the 2030 Agenda, the result of an agreement signed in 2015 by the 193 member states of the United Nations (UN), in which they committed to following the guidelines recommended in the document "Transforming Our World: The 2030 Agenda for Sustainable Development" for the next 15 years, from 2016 to 2030 (Resolution, 2015).

With the exception that it can be adjusted to the reality of each country, it is a global action plan composed of 17 sustainable development goals (SDGs) and 169 targets, with which the aim is to create conditions to eradicate poverty and promote a dignified life for everyone, observing the conditions offered by the planet and without compromising the quality of life of subsequent generations. In a complementary way, the objectives and goals defined in the 2030 Agenda proved to be integrated and decentralized, covering the social, environmental, and economic dimensions of sustainable development. They can be put into practice by both public

and private organizations, such as governments, civil society, and the private sector, as well as by every citizen concerned about the future of future generations. More than that, it opened up the possibility for economic agents and governments to be monitored and directly charged to put sustainable actions into practice (Resolution, 2015). It should be noted that the SDGs permeate a series of themes and dimensions of society, and what is postulated in this article particularly meets SDG-6: "By 2030, achieve universal and equitable access to water for human consumption, safe and accessible for everyone".

For example, institutions such as the World Bank (2016) do not escape this charge. The World Bank's Environmental and Social Framework establishes a commitment to sustainable development through a specific bank policy guideline. This framework is a set of environmental and social standards designed to support borrowers' projects that aim to end extreme poverty and promote shared prosperity. The bank's environmental and social policies are known as "Safeguard Policies", a mechanism to address environmental and social issues in project design, implementation, and operation (Park, 2010).

The institution provides funding to governments for projects, such as building roads, connecting people to electricity, or treating wastewater, to ensure that people and the environment are protected from possible negative effects. Among the political guidelines for granting financing and obtaining support from the bank in investment projects, governments must take responsibility for taking care of some specific environmental and social risks, contributing to identifying, preventing, and minimizing damage to people and the environment (Banco Mundial, 2016; Park, 2010).

Intending to engage companies and organizations in the adoption of ethical principles and values in the areas of human rights, work, and the environment, the Environmental, Social, and Governance (ESG) initiative, in partnership with the World Bank, consolidates standards and guidelines into a method to determine whether companies' operations and businesses are socially responsible, sustainable and well managed (Gassmann et al., 2021).

Business strength is, above all, one of the most important factors for the growth and development of society. However, for a long time, company managers believed that their main objectives were limited to generating jobs and creating goods and services to meet the needs of their customers and consumers (Lokuwaduge & Heenetigala, 2017). The business world, however, is responsible for the dynamism and development of the community in which it operates and must create programs and projects that consider nature, the economy, education, health, local activities, transport, and other relevant factors. From this perspective, ESG works with social needs and business opportunities, unifying them to transform how companies develop strategies, boost their performance, and report the results obtained (Buallay, 2019; Gassmann et al., 2021).

As agents, managers, analysts, and participants in the business, corporate, or "second sector" world address and incorporate into their practices a wide range of social, environmental, and governmental issues, the need emerges to standardize the set of reports for the dissemination of implemented actions and achieved results. The standards of the Global Reporting Initiative (GRI) are the globally referenced basis for preparing sustainability reports, which highlight the organization's impact on the economy, the environment, and people's living conditions and, in this way, are aimed at a public comprised of many interested parties (Silva et al., 2014). Therefore, the organization can use the information disclosed to evaluate its policies and strategies, guide decision-making, and establish goals and plans that correspond to the objectives outlined by the 2030 Agenda (Global Reporting Initiative, 2021).

At the same time, it is important to highlight that, among the inputs used in human activities and supplied by the natural environment, water summarizes and constitutes the greatest paradigm of sustainability and ensuring safety and quality of life (Li et al., 2019; Tshimanga et al., 2021).

In fact, by examining the energy, food, and water resource sectors, it is possible to observe situations of insecurity often arising from using sectoral strategies that manage these

resources in a simplified way and isolated from their connection with other interconnected dimensions such as water. In this way, a strategic means of intervention, designed to equalize the challenges imposed by global economic conditions and the premises for achieving full sustainable development, is subject to compliance with water, energy, and food security and, consequently, sustainability assessed in the Water-Energy-Food (WEF) NEXUS (Pahl-Wostl, 2019).

This challenge also encompasses the human dimension, which includes compliance with the fundamental rights of access to water and sanitation, given that global assessments of current supply and demand and prospects for future growth allow us to estimate a significant scarcity of water and food due to excessive use and depletion of natural sources of supply. By adopting the WEF-NEXUS approach for the management of water resources, we work with the possibility of achieving a balance between universal access to minimum standards of water, energy, and food. Using and applying different assessment methods, modeling techniques, and risk analyses, the social, economic, and environmental impacts involved in decisions relating to technological innovation and policy design are understood (Pahl-Wostl, 2019; Scanlon et al., 2017).

To achieve a sustainable management model, the main parameters for decision-making are the territory's economic, social, and environmental configurations. They allow objective conditions for people to remain in their homes and enjoy adequate living conditions, especially when it comes to the intermittency of hydrological cycles and their unequal distribution. If this issue is not well addressed, it will result in the construction of territorial structures in which the value of water as an economic good will outweigh its social or environmental value, as it will become scarce and, in some way, selective in its distribution (Hogan & Marandola Jr, 2009).

When considering the realization of the right of human access to water, however, the objective of SDG-6 by 2030 – which is to achieve universal and equitable access to safe and drinking water for all (Resolution, 2015) – collides with the interests of selective measures that

weigh on the technical, operational, or financial capabilities to achieve what is foreseen in this objective. This issue is highly complex, difficult to resolve, and without sufficient support in studies and academic research. With the expectation of contributing to the forwarding of discussions regarding the theme of universal access to water and sanitation, the objective of this work is, based on the case study of the Piracicaba, Capivari, and Jundiaí (PCJ) river basins, located in the Southeast region of Brazil, to evaluate whether water resource managers dimension, integrate or provide for the right to water and sanitation for populations that, due to their social, economic condition or geographical distribution, are in a situation of territorial vulnerability.

The text is subdivided into three main parts. In addition to the thematic contextualization presented in this introduction, the first part presents the theoretical foundation, authors, and the main theoretical concepts used in the study. The following section describes the materials and methods used in data collection, analysis, and processing. Finally, the research results are offered, analyzed, and discussed in the third part.

Vulnerable territories and the water crisis in Brazil

Santos (2015) emphasizes that in Brazil, in particular, and in developing countries, in general, the demographic concentration in urban environments was not accompanied by corresponding improvements in infrastructure conditions necessary to adequately meet the most basic needs, exposing the population to risks and threats. Moreover, the author recommends observing the close relationship between environmental fragility, social vulnerability, and a context of limited response to identify territories vulnerable to socio-environmental risks. It is in the combination of these elements that natural phenomena can trigger a crisis.

It is important to keep in mind that the precarious urban conditions, extreme poverty, and social vulnerability present in developing countries will pose significant challenges to limiting the negative effects of climate change on the population. Changes in precipitation patterns, more

frequent climate extremes, heat waves, or worsening prolonged dry periods can potentially cause serious damage to the most vulnerable populations (Turner II et al., 2003).

Furthermore, as different sociodemographic groups also find themselves in different socio-territorial situations regarding exposure to environmental disasters, they are similarly disadvantaged when protecting and caring for their health (Lanier et al., 2019). Therefore, it is necessary to distinguish between vulnerable and depressed territories. While vulnerable territories are geographical spaces (regions, districts, cities, and environmentally fragile rural areas) that are subject to environmental impacts and suffer from a lack of adequate infrastructure, depressed territories are characterized by having social and economic indicators placed at a level lower than the others (MES RK Institute of Economics, Almaty, Kazakhstan, et al., 2022). In Brazil, changes in land use and coverage, the construction of dams and water structures, the pollution of water resources, and the excessive use of these resources for the production of goods and services affect the quality and availability of water in all biomes (C. Nobre et al., 2016). Extreme droughts and floods linked to climate change increase concerns about the systems and management of water resources, especially in large Brazilian cities. Taking into account social norms, values, and practices, it is in urban areas that these changes will have the greatest impact, mainly because the accumulation of environmental issues and conflicts have not yet been resolved. At the same time, cities will serve as focal points for big conversations, social changes, and challenges posed by emerging climate scenarios (Hogan & Marandola Jr, 2009).

Territories are spaces delimited by the interaction between geographic, sociopolitical, and informational elements. It involves observing and bringing together human activity in a single figure, unit, or denomination and its effects on the soil, fauna, flora, natural resources, and how landscape elements are used. Moreover, it is a historical construction whose result inexorably characterizes the environment and its multiple facets and subdivisions. As Dirce Koga (2003) states, territory is also the ground of public policies, where the actions and

interests of different social groups are listed, negotiated, implemented, or neglected. River basins would be, in this conception, the physical, social, cultural, and political space whose organizing elements are watercourses and how human communities appropriate them in their wide spectrum of possibilities for the use and consumption of water resources.

According to the declaration of the United Nations Conference on the Environment, held in Stockholm in 1972, protecting and improving the environment for current and future generations has become a critical goal for humanity (Passos, 2009). As a result, intentions and recommendations were established that would serve as a guide for formulating and implementing public policies in each participating country, taking into account concerns about the development of natural resources and sustainable use. The latter is understood as a series of actions directed or planned to occur in a continuous and stable manner, avoiding deviations, threats, or risks that could compromise its existence in the medium and long term (Hamu & Costa, 2003).

While the variability and alternations of the water cycle can pose a threat to meeting the needs of a given population, risk refers to the statistically measurable probability that this threat will materialize. Therefore, vulnerable territories will be spaces where risks can become a reality in greater proportions or where it is impossible to adopt palliative or resilient measures to guarantee water security (Mariosa et al., 2015).

Water security, in turn, refers to ensuring the universality and completeness of reliable and sufficient access to qualitatively safe water, without obstacles or economic impediments, and available without distinction to all people. However, for this to occur, the ecosystems in which water resources circulate must be conserved so that people can have a healthy, dignified, and productive life. Certainly, "[...] when these conditions are not maintained, or when access to water is interrupted, people face serious human security risks [...]", whether transmitted by health or even by disruptions in obtaining livelihoods and subsistence (Neves, 2019, p. 10). Small communities will suffer from a lack of infrastructure, coordination capacity, alarm systems,

and institutional structures capable of responding to natural disasters and environmental impacts, as it will be in megacities that we will face the challenges of large numbers, which will test our ability to overcome the diverse difficulties. Recognizing, identifying, and mapping the population's vulnerabilities and risks will allow us to understand the procedures that lead to the feasibility or viability of adaptation policies and measures. Alternatively, put another way, the structure of urban space, the way it develops, and the expansion of urban land need to be considered in medium and long-term urban planning in order to maximize the possibility of minimizing the effects of environmental impacts (Hogan & Marandola Jr, 2009; C. A. Nobre et al., 2011).

The institutional framework in Brazil that regulates Water Resources Management is outlined in Law No. 9,433 of January 8, 1997, which establishes the National Water Resources Policy, and creates the National Water Resources Management System (Brasil, 1997). Among other measures, Article 7 of Law No. 9,433 states that Water Resources Plans are long-term plans with a planning horizon compatible with the implementation period of their programs and projects. Within the territorial scope delimited by hydrographic basins, the Basin Plans have the following minimum content: §I - diagnosis of the current situation of water resources; §II - analysis of alternatives for demographic growth, evolution of productive activities, and changes in land occupation patterns; §III - balance between availability and future demands of water resources, in quantity and quality, with identification of potential conflicts; §IV - goals for rationalizing use, increasing the quantity and improving the quality of available water resources; §V - measures to be taken, programs to be developed and projects to be implemented, to meet the expected goals; §VIII - priorities for granting rights to use water resources; §IX - guidelines and criteria for charging for the use of water resources; §X - proposals for the creation of areas subject to restricted use, to protect water resources (Brasil, 1997).

Brazil has the largest amount of fresh water, with 12% of the total on the planet, surpassing the entire European or African continents. However, despite this characteristic, the

lack of implementation of sustainable management of water resources, taking into account the various regional characteristics and effects linked to land use, as well as climate change, will lead us to have difficulty in achieving the expected goals of sustainable development (C. A. Nobre et al., 2011). The lack of rain cannot be a sustainable argument to justify the water crises that the country is experiencing; the lack of long-term strategic planning is paramount in this issue, including adequate water resources management policies and environmental education among the population and companies. The absence of these factors leads to high pollution levels and water scarcity (Cutter et al., 2012).

Methodological Approach

Considering the main premises of the strategic management of water resources exposed here, their conflicts, and limitations, the research analyzes the results of the actions of the water resource managers of the PCJ river basins to verify whether the right to water and sanitation is universally distributed in this territorial space.

To achieve the proposed objective, the methodological path adopted consists of a bibliographical review of the literature to contextualize the theme and a specific analysis of the Water Resources Situation Report in the PCJ Basins 2021 (base year 2020), produced by the technicians of the Committees and Agency of the PCJ Basins (Comitês, 2021).

This is, therefore, a qualitative, descriptive, exploratory, and documentary-based study on the scientific production of vulnerable territories and the issue of water resources (Creswell & Clark, 2015; J. C. R. Pereira, 2004). The bibliographical survey was carried out using public documents and secondary sources available on the PCJ Basins, in addition to academic texts for theoretical foundations and institutional websites. We chose to analyze graphs and tables from the Report on the Status of Water Resources in the PCJ Basins 2021 (base year 2020) to verify how access to water is made available to populations in a state of territorial vulnerability and, in this way, recover the most diverse strategies present in water management programs

observed when examining the actions, goals, and indicators that contribute to the level of priority assigned by public and private agents in the management of water resources.

The right to access water and sanitation in the hydrographic basins of the Piracicaba, Capivari, and Jundiaí rivers

The research results are based on data on the distribution of the percentage of water and sanitation in the territories supplied by the PCJ river basins. Tables are examined on the assessment of the total availability of water resources, water supply in urban spaces, losses in distribution systems, and the assessment of the quality of basic sanitation, with indices on the collection and treatability of sanitary sewage in the regions studied.

In a comparative table (Figure 1), from 2016 to 2020, the amount of water offered in the territories of the analyzed regions is considered critical, and the total per capita availability of water resources in these locations is decreasing.

Figure 1

Summary of the situation of water resources in the PCJ Basins

Water availability					
Parameters	**2016**	**2017**	**2018**	**2019**	**2020**
Per capita availability - Average flow concerning the total population (m^3/inhabitant/year)	**990,92**	**980,96**	**971,08**	**961,29**	**951,57**

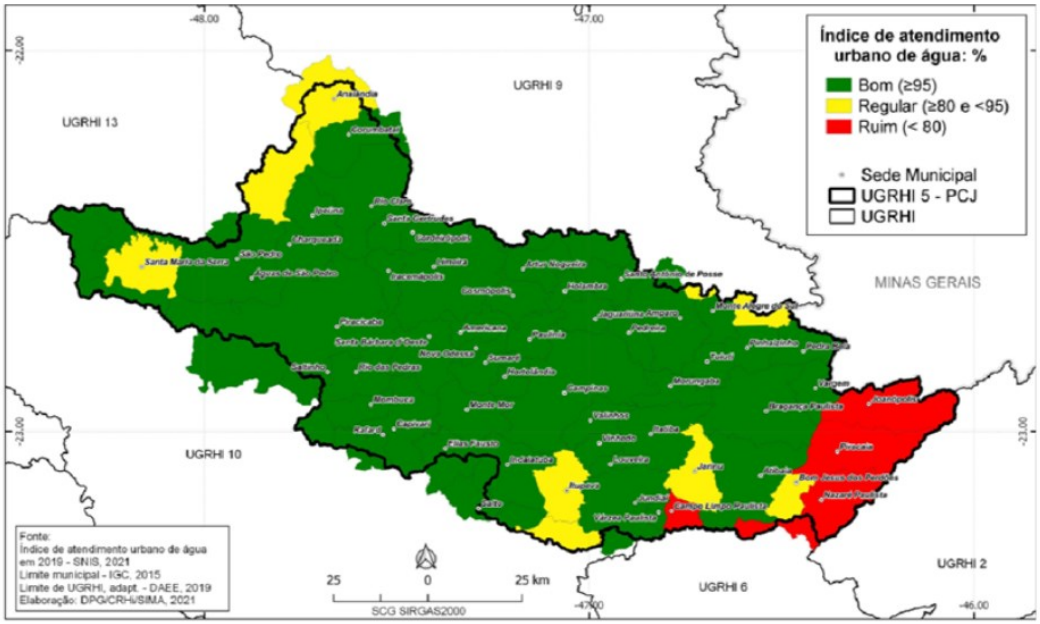
Reference Values for per capita availability	
Per capita availability - Average flow concerning the total population	
> 2,500 m3/inhabitant year	**ATTENTION**
between 1,500 and 2,500 m3/inhabitant.year	**GOOD**
< 1,500 m3/inhabitant year	**CRITICAL**

Source: PCJ Committees. Report on the Status of Water Resources in the PCJ Basins 2021 (base year 2020) (Comitês, 2021).

Although, in general, the amount of water available in the PCJ Basins area is at critical levels, it is observed, however, that in most municipalities, specifically in urban regions (Figure 2), water supply has an index considered good (i.e., with a service percentage ≥95%). In other places, however, coverage is at a regular rate (i.e., 80–95%) as in Analândia, Santa Maria da Serra, Itupeva, Jarinu, Bom Jesus dos Perdões and parts of the municipalities of Monte Alegre do Sul, Pinhalzinho and Pedra Bela. Below 80% of urban service highlights the negative or poor regions, including Campo Limpo Paulista, Nazaré Paulista, Piracaia, and Joanópolis. Therefore, despite the total water availability being considered insufficient, supply services can reach their consumers in urban regions. As for rural areas, service is precarious or non-existent.

Figure 2

Urban water service index



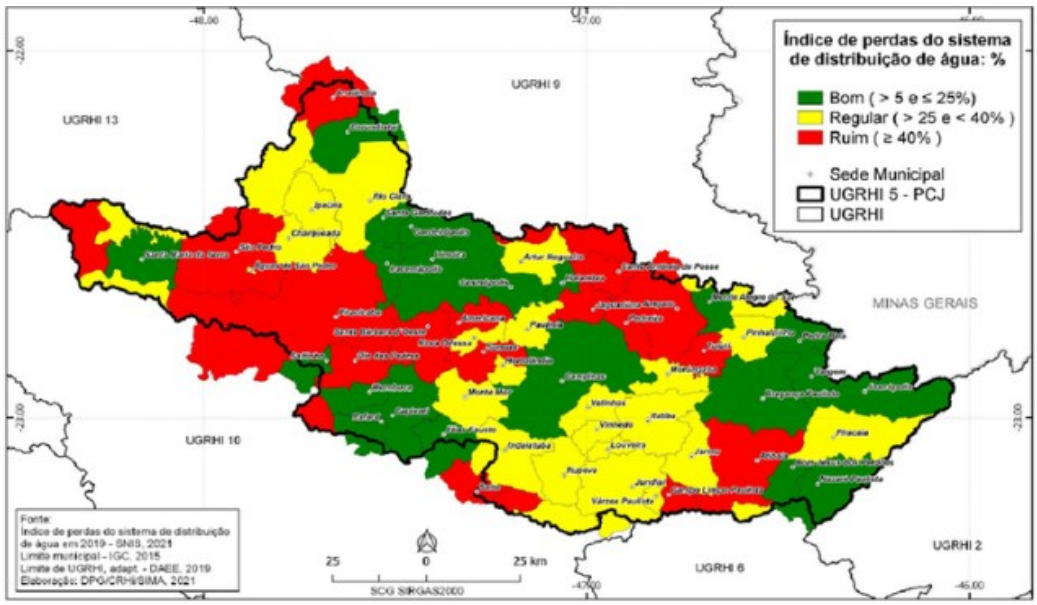
PCJ Basins	
URBAN WATER SERVICE INDEX	
≥ 95%	**GOOD**
≥ 80% and < 95%	**REGULAR**
< 80%	**BAD**

Source: PCJ Committees. Report on the Status of Water Resources in the PCJ Basins 2021 (Base year 2020) (Comitês, 2021).

Loss control becomes an effective mitigating measure as the available water volumes cannot supply the entire population. However, concerning the loss percentage, few presented a rate considered good. The majority have a loss rate that is fair or poor (Figure 3).

Figure 3

Loss rate of the water distribution system



PCJ Basins	
LOSS RATE OF THE WATER DISTRIBUITION SYSTEM	
> 5% and ≤ 25%	GOOD
> 25% and < 40%	REGULAR
≥ 40%	POOR

Source: PCJ Committees. Report on the Status of Water Resources in the PCJ Basins 2021 (Base year 2020) (Comitês, 2021).

While many of the municipalities that have good urban water services still suffer from losses of water resources, others that have worse quality water services, such as Santa Maria da Serra, Nazaré Paulista, Piracaia, and Joanópolis, appear to invest better in their supply planning. On the other hand, administrations like those in Analândia and Campo Limpo do not demonstrate that they prioritize actions in this direction, even though the localities suffer from the lack of resources.

With the basic sanitation conditions in the territorial space of the PCJ Basins (Figure 4), sewage collection rates were well classified every year from 2016 to 2020, reaching 93.7% of

urban properties in 2020. Regarding its treatment and reduction, the rates pointed to a regularly increasing efficiency, varying between 73.1% in 2016 and 89% in 2020.

Figure 4

Basic sanitation - sanitary sewage

Basic sanitation - sewage					
Parameters	**2016**	**2017**	**2018**	**2019**	**2020**
Collected sewage (%)	91	92,2	93,3	93,3	93,7
Treated sewage (%)	73,1	76,1	76,8	77,8	80,2
Reduced sewage (%)	64,9	67,9	67	66,6	69,3
Remaining sewage (Kg $BOD_{5.20}$/day)	102,569	94,777	98,961	101,174	93975

Reference Values for the parameters Collected sewage, Treated sewage and Sewage system efficiency	
Collected sewage, Treated sewage	
< 50%	POOR
≥ 50% and < 90%	REGULAR
≥ 90%	GOOD
Reduced sewage	
< 50%	POOR
≥ 50% and < 80%	REGULAR
≥ 80%	GOOD

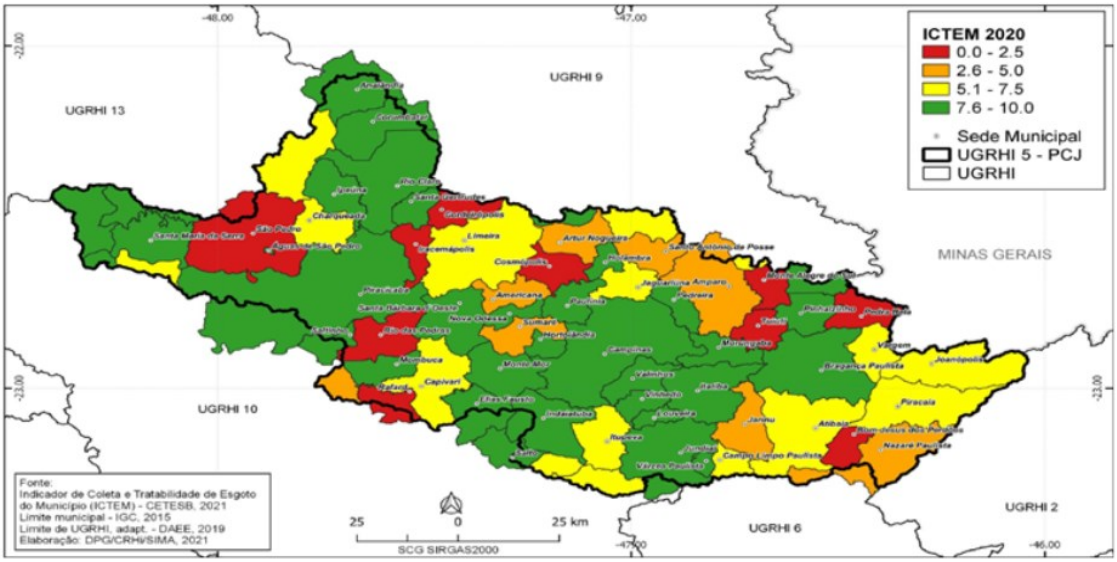
Source: PCJ Committees. Report on the Status of Water Resources in the PCJ Basins 2021 (Base year 2020) (Comitês, 2021).

It is understood that there was an effort to increase the treated sewage rate, as the percentage—even though it remains within the same reference range—has increased each year. Investment to reduce sewage varied between years and, in 2020, achieved its best percentage, 69.3%.

Regarding municipalities, most of them had good sewage collection and treatment rates (Figure 5). In turn, the municipalities that showed less well-classified indexes regarding the Sewage Collection and Treatability Indicator of the Urban Population of Municipalities (ICTEM) put pressure on the general condition of sewage treatment in the regions of the basins analyzed. On the other hand, they point out where and how improvement actions should be prioritized.

Figure 5

Sewage collection and treatability indicator for the urban population of a municipalities - ICTEM



Sewage collection and treatability indicator for the urban population of a municipalities (ICTEM)	
ICTEM	**RATING**
0 < ICTEM ≤ 2,5	**VERY BAD**
2,5 < ICTEM ≤ 5,0	**BAD**
5,0 < ICTEM ≤ 7,5	**REGULAR**
7,5 < ICTEM ≤ 10	**GOOD**

Source: PCJ Committees. Report on the Status of Water Resources in the PCJ Basins 2021 (Base year 2020) (Comitês, 2021).

In this aspect, there is a contradiction between municipalities that have more qualified access to water in urban areas, such as Cosmópolis, Artur Nogueira, Santo Antônio de Posse, Amparo, Rio das Pedras, Rafard, and São Pedro, but do not invest in the infrastructure in the city, in this case, presenting rates that vary from 0% to, at most, 5% of sewage collection and treatment. The municipality of Bom Jesus dos Perdões has poor sanitation, in addition to not having good urban water service. On the other hand, regions such as Campo Limpo Paulista,

Piracaia, Joanópolis, Analândia, Santa Maria da Serra, and Itupeva, which also suffer from this access in urban areas, demonstrate better investment in the treatment and collection of their sewage.

Conclusions

Drinking water is a natural and finite resource on planet Earth, essential for maintaining life. In 2015, the United Nations listed objectives for sustainable development to be achieved by its members by 2030. Among them, in SDG-6, the organization understood that access to water, seen as a social right, should be universal and equitable.

In parallel, by understanding the seriousness of the present and future water availability situation, researchers and environmental activists defend the importance of preserving water resources through good planning management by states and governments. Furthermore, research and discussions indicate that, to achieve sustainability, these preservation strategies also need to be considered in the energy and food sectors, and there must be combined public policies for the non-exploitative development of the planet.

On the other hand, in the theoretical framework presented here, the authors reinforce that there is an ongoing environmental crisis in the world, which includes Brazil, despite efforts to achieve sustainability objectives in the environmental, economic, and social dimensions. The inhibition of access to social rights has been justified by criticism of climatic and environmental conditions; however, this is not a reality that is impossible to overcome, with strategic planning being the key to this change.

The present study sought to contribute to the analysis of the objective conditions of access to water and sanitation, specifically evaluating aspects of the management of water resources in the municipalities and territories supplied by the hydrographic basins of the PCJ rivers based on the Report on the Situation of Water Resources in PCJ Basins 2021 (base year 2020.

Although restricted to the limits of the article, the analysis points to a reduction in water availability in the analyzed regions, which is decreasing and at a critical level. This result means that there are insufficient resources, putting managers on alert so that, in their actions, they find ways so that those in the most vulnerable territorial areas are not excluded from access to water. As represented in the maps brought to this article, the right to water is not considered a universal right in these territories. However, with investments in creating efficient infrastructures to avoid losses in distribution systems and provide quality basic sanitation, with sufficient collection and treatment, some difficulties could be reduced.

Public water supply services are widely available in most urban regions of the territories. However, this is not enough for quality access, as, in many cases, the flow is undersized or out of balance with demand. Despite access points to water resources in these locations, the poor and regular distribution rates indicate that they do not reach the population with the efficiency, pace, or quantities they could and should reach.

Additionally, the lack of sewage collection and treatment causes health risks, requiring managers to devise strategies to regularize and universalize basic sanitation. In the territorial coverage area of the PCJ Basins, although in general terms, sewage collection has good rates, when evaluating the situation of each municipality separately, it is clear that pockets with terrible and poor rates for collection and treatment persist.

Finally, we suggest that water resource managers in the PCJ Basins prioritize actions to recognize water and sanitation as a right in their social value. Access to this resource cannot only be of high quality in territories with greater economic development, such as the metropolis of Campinas, where there are good rates in all aspects considered in this study, but it covers all municipalities and their sub-regions without distinction.

The cultural, social, and economic heterogeneity of population groups, the differentiated relationship in terms of quantity and quality that they maintain with available water resources, and the uncertainties and variability of the water cycle segment territories increase the threats

and risks that make them more or less vulnerable in terms of access to water and sanitation. Now, the main premise for managing water resources cannot fail to be the commitment to sustainable practices. These, in turn, correspond in different magnitudes and political and institutional implications with the social, economic, and environmental dimensions of sustainability. The forms of management, depending on the guideline, value, or privileged principle to guide planning actions, be it social, environmental, or economic, will point to the main strategic challenges of administration, as well as determine the difficulties faced in the territory for access to this common and finite good that is water.

It is concluded that judging by the conditions of supply, water, and sewage treatment in the regions analyzed, the right of access to water and sanitation for the population in situations of territorial vulnerability in the municipalities covered by the PCJ Basins is not completely implemented. Although indicating flaws and limits of this universalization, the results achieved are preliminary and limited to the object studied. For the development of the theme, additional studies are necessary so that alternative practices to those already being implemented can be expanded. Furthermore, these discussions can be used in educational campaigns that raise awareness and encourage the population's participation to improve access to this right.

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